MELT EXTRACTION BY MIXING AND ELEMENT DIFFUSION IN ALKALINE BASALTIC MAGMAS

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Most of the intermediate and acid volcanics in the Tertiary volcanic region of the Westerwald (Rhenish Massive, Germany) show a clear evidence for magma mixing: small spherical inclusions (globules) generated by intrusion and dispersion of a hotter guest melt within a cooler host. This process is well documented in the field by a subvolcanic trachytic body penetrated by a latitic dyke (Schreiber 1996). Basaltic globules are less than 3mm in diameter and have a duller glow compared to the host rock. A characteristic mineralogical feature is a completely irregular pattern of plagioclase and clinopyroxene. In the host rock, these minerals are strongly flow regulated. Within the globules, olivine phenocrysts also abundant in the host rock are almost completely transformed to fine aggregates of chlorite. Other features of the globules are the presence of analcite and glass and a lower content of Fe-Ti-oxides. Mircoprobe measurements show a diffusive enrichment of the alkalis in the matrix of the globules. Vice versa, Mg, Ca, Fe, and Ti have migrated into the host, resulting in an almost phonolitic composition of the globule matrix. Bulk contents of trace elements in the globules and the host show also a diffusive migration of trace elements pointing to different element affinities to both melts. The globules have been preserved by eruption during the diffusion processes. If diffusion continues over a long time and under ideal conditions, physical and chemical properties of the globules change seriously: the density is lowered by the input of lighter elements and the increased alkali content results in a lower melt temperature. Therefore, the globules rise up in the host melt by continuing diffusive element exchange. An aggregation of the globules in the roof of the magma chamber makes a generation of an alkali rich extraction melt possible. In the Westerwald this is documented by volcanic rocks totally consisting of globules (Schreiber et al 1996). This kind of melt extraction is supposed to be important for the genesis of undersaturated alkaline rocks and for the problem of bimodal volcanism.